
STEAMER

Contents

Progress and Reassessment 2001–2007

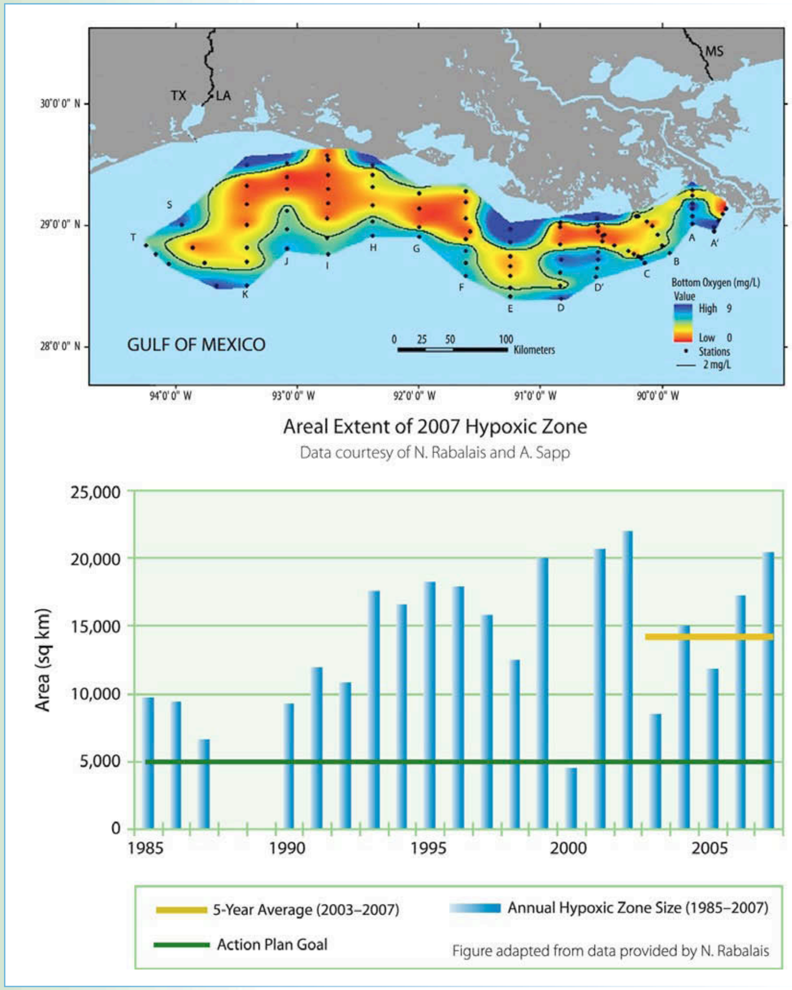


Figure 2. Size of Gulf Hypoxic Zone

Trends in the Size of the Hypoxic Zone

The hypoxic zone in the Northern Gulf of Mexico forms each summer and can extend up to eighty miles offshore and stretch from the mouth of the Mississippi River westward to Texas coastal waters. The size of the hypoxic zone varies considerably each year, depending on natural and anthropogenic factors. In 2007, the measured size of the hypoxic zone was 20,500 square kilometers (7,900 square miles), about the size of the state of Massachusetts, the third largest hypoxic zone since measurements began in 1985 (Figure 2). The goal of this Action Plan is to reduce the five-year running average size of the zone to less than 5,000 square kilometers (about 1,900 square miles). The current five-year average (2003–2007) is 14,644 square kilometers (5,600 square miles), more than twice the size of the goal.

Trends in Nitrogen and Phosphorus in the Basin

With a twenty-year average (1985–2005) annual stream flow of over 20,000 cubic meters per second, the Mississippi River carries large amounts of sediments and nutrients from its watershed, resulting in large nutrient loads* delivered to the Gulf of Mexico at the river terminus. Nutrient loads vary greatly and are positively related to streamflow. According to the United States Geological Survey (USGS), between 1985 and 2005, nutrient loads ranged from lows of 810,000 metric tons of nitrogen and 80,700 metric tons of phosphorus to highs of 2,210,000 and 180,000 metric tons of nitrogen and phosphorus, respectively (Figure 3).

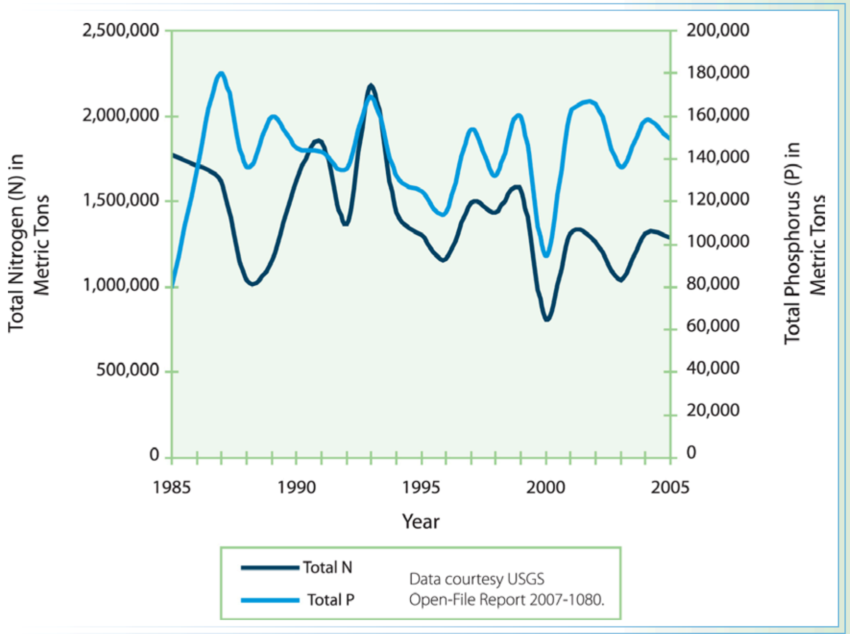


Figure 3. Nutrient Loads in the Mississippi/Atchafalaya River Basin (1985–2005)

It is especially important to understand the sources of these nutrient loads that flow into the Gulf of Mexico. Analysis of five-year averages, from 2001–2005, of nutrient loads from the various sub-basins indicates that 80% of the nitrogen load delivered to the Gulf of Mexico came from the Ohio/Tennessee and

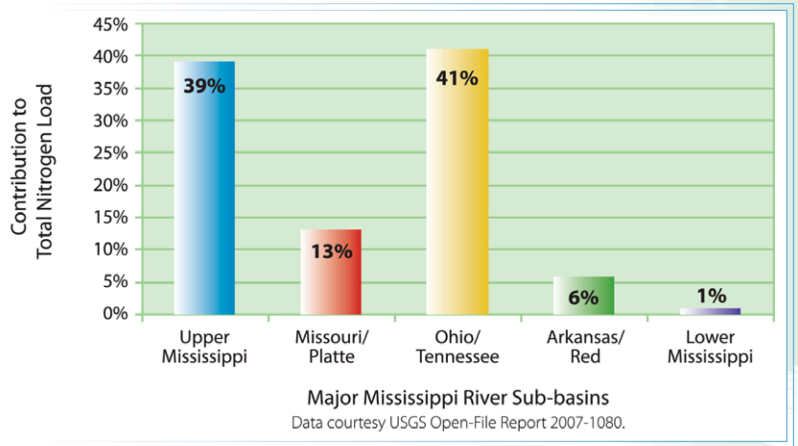


Figure 4. Nitrogen Loads to the Gulf by Sub-basin (2001–2005 average percentage)

*Load (often called flux) is the amount (mass) of a chemical in a river that passes a given point over a given period of time. It is calculated by multiplying the average streamflow (discharge) of the river by the average concentration of that chemical in the river over that time period.

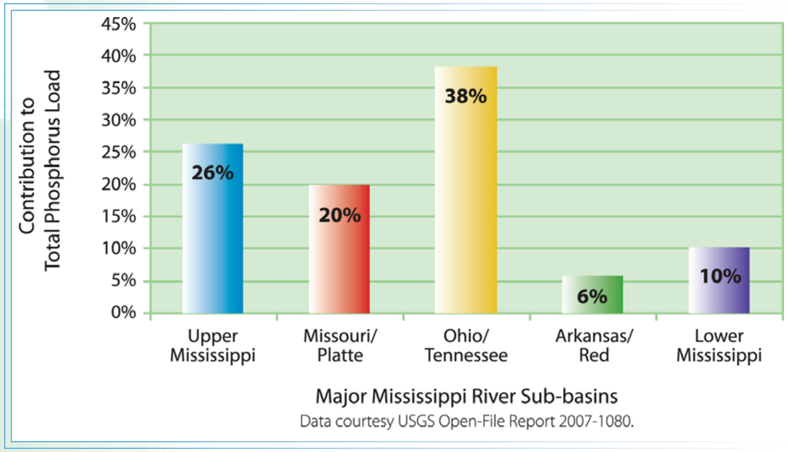


Figure 5. Phosphorus Loads to the Gulf by Sub-basin (2001–2005 average percentage)

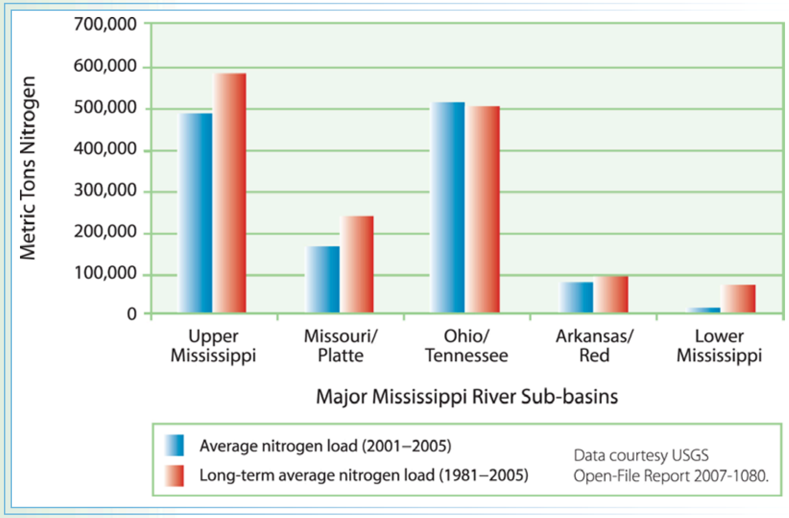


Figure 6. Mississippi River Basin Nitrogen Load by Sub-basin

Upper Mississippi River Sub-basins (Figure 4), which contributed 41% and 39% of the load, respectively. Similar analysis shows that from 2001–2005, the Ohio/Tennessee and Upper Mississippi River Sub-basins were the greatest contributors of phosphorus loads to the Gulf of Mexico as well, contributing 38% and 26%, respectively (Figure 5). The Missouri/ Platte, Lower Mississippi, and Arkansas/Red Sub-basins contributed 20%, 10%, and 6%, respectively.

Figures 6 and 7 show both the long term average and the most recent 5-year average (for which data is available) nitrogen and phosphorus loads for each sub-basin in the Mississippi/Atchafalaya River Basin.

Overall, total annual loads to the Gulf from 2001–2005 show a 21% decline in nitrogen load and a 12% increase in phosphorus load when compared to the average from the 1980–1996 period. However, during the spring period (April, May, and June) most of the reduction in total nitrogen load was from nitrogen forms other than nitrate, an important form fueling the primary production that leads to hypoxia development in the spring.

Progress on Actions in the *2001 Action Plan*

Of the eleven actions identified in the *2001 Action Plan*, several have made significant progress:

- The States established Sub-Basin Committees for the Upper Mississippi Basin, the Ohio Basin and the Lower Mississippi Basin. These committees have worked to coordinate actions in the sub-basin states. The Sub-Basin Committees have opened the discussion to include many stakeholders not represented on the Task Force, including additional basin states, state agencies, and interested parties and organizations. (*Action 2 of 2001 Action Plan*)

- The Task Force issued an integrated monitoring, modeling and research strategy (MMR workgroup report), for the Basin and Gulf to guide the development of the nutrient reduction strategies as well as future scientific research. The MMR workgroup report was a driver for research strategies of the National Oceanic and Atmospheric Administration's (NOAA) Northern Gulf of Mexico Ecosystems and Hypoxia Assessment Program, which supported studies advancing understanding of causes and impacts of the hypoxic zone. (*Action 3 of 2001 Action Plan*)

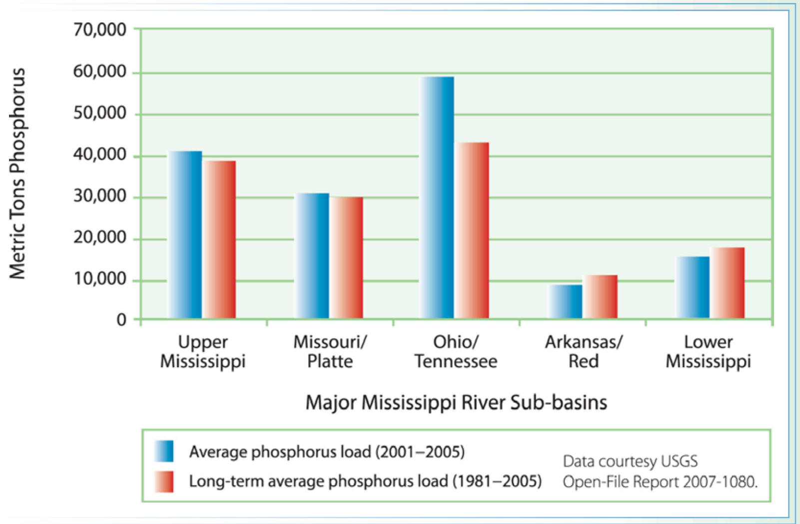


Figure 7. Mississippi River Basin Phosphorus Load by Sub-basin

- After detailed planning and building on the recommendations of the MMR workgroup report, NOAA conducted additional monitoring of the hypoxic zone on a seasonal and annual basis, though this has not "greatly expanded" the long-term monitoring program, as many important needs persist (see next section). (*Action 4 of 2001 Action Plan*)

Millionth CREP Acre Enrolled

In the Fall of 2007, USDA enrolled farmland in Minnesota as the one millionth acre in its nationwide Conservation Reserve Enhancement Program (CREP).

CREP is a community-based, results-oriented effort that focuses on local participation and leadership and addresses high-priority conservation issues of both local and national significance, such as impacts to water supplies, loss of critical habitat for threatened and endangered wildlife species, soil erosion, and reduced habitat for fish populations.

As a component of USDA's Conservation Reserve Program administered by the Farm Service Agency, CREP is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat and safeguard ground and surface water. Partnering with tribal, state and federal governments and private groups, USDA establishes contracts with agricultural producers to retire highly erodible and other sensitive cropland and pastureland. During the 10- to 15-year contract period, participants convert enrolled land to grass, trees, wetlands, wildlife cover and other conservation uses. CREP supports increased conservation practices such as filter strips and forested buffers, which help protect streams, lakes and rivers from sedimentation and agricultural runoff.

Farmers in local communities deserve much of the credit for CREP's overwhelming success. Without their commitment to CREP, this innovative program would not have reached this milestone.

- Higher resolution spatial data were added to large watershed-scale models to help identify smaller watersheds for focused nutrient reduction efforts. (*Action 5 of 2001 Action Plan*)

- The Ohio and the Lower Mississippi Sub-Basins began development of nutrient reduction strategies at the sub-basin level, incorporating specific issues and proposals from the states within those basins. (*Action 6 of 2001 Action Plan*)

- Increased assistance to agricultural producers through U.S. Department of Agriculture (USDA) programs for voluntary actions resulted in an additional 1.4 million acres of wetlands restored, enhanced, or created and an additional 2.3 million acres of conservation buffers installed within in the Basin during fiscal years 2000–2006. (*Action 9 of 2001 Action Plan)*

- Increased assistance to agricultural producers through USDA programs for the voluntary implementation of best management practices, which are effective in addressing loss of nutrients to water bodies, has resulted in conservation tillage/ residue management practices applied to

20.8 million acres and nutrient management applied to 18.3 million acres in the Basin during fiscal years 2000–2006. A total of 42.8 million acres of conservation tillage, nutrient management, wetland, and conservation tillage practices were applied, not counting additional areas impacted by wetland and buffer practices. *(Action 10 of 2001 Action Plan)*

- The Task Force completed a major reassessment of the science and actions to support the Action Plan principle of adaptive management. (*Action 11 of 2001 Action Plan*)

However, some of the actions called for in the 2001 plan have not been initiated, authorized or completed:

- An integrated federal budget that would have supported voluntary actions to reduce nutrient pollution in the Basin and thereby the size of the hypoxic zone in the Gulf was never finalized. (*Action 1 of 2001 Action Plan*)

- The long-term monitoring program for the hypoxic zone has not been "greatly expanded," and uncertainties remain in the ability to characterize the spatial and temporal dynamics of hypoxia and the biological, chemical, and physical properties that contribute to it. *(Action 4 of 2001 Action Plan)*

- Water quality monitoring in the Basin has not significantly increased and in some cases long term stations included in the USGS network have been discontinued. (*Action 5 of 2001 Action Plan*)

- Although some work has begun on the development of nutrient strategies at the sub-basin level, much work still needs to be accomplished. *(Action 6 of 2001 Action Plan)*

- Congress did not authorize and fund a reconnaissance-level study for the U. S. Army Corps of Engineers (USACE) and partners to specifically assess the potential for nutrient reductions in federal (EPA, U.S. Fish and Wildlife Service (FWS), National Resources Conservation Service (NRCS), USACE) river and farmland management, refuge management, and navigation projects. Without specific Congressional language, work could not commence. *(Action 7 of 2001 Action Plan)*

Nutrients reach rivers in the Mississippi/Atchafalaya River Basin through urban stormdrains.

Scientific Basis for Hypoxic Zone Management

With a commitment greater than $12.5 million since 2001, NOAA has continued to provide the scientific foundation on Gulf of Mexico ecosystem dynamics upon which management of the hypoxic zone is based. As part of this commitment, annual monitoring of the hypoxic zone provides the benchmark for which progress on Action Plan goals is measured. Utilizing an ecosystem-based approach, NOAA research studies have led to enhanced predictive models capable of examining a multitude of interacting factors on the size of the hypoxic zone, and provide information on how hypoxia affects commercially and ecologically important species in the region. These models are integrating oceanographic physical data and coastal biogeochemistry to improve quantification of the duration, timing, and extent of the hypoxic zone, and their relationship to causative factors such as nutrients and stratification. These model predictions of complex processes will continue to allow for the comprehensive assessment of alternative management strategies to mitigate hypoxia in the Gulf of Mexico.

- Additional analysis of detailed nutrient pollution contributions from multiple sectors, including point sources and non-agricultural contributions, needs to be undertaken. (*Action 8 of 2001 Action Plan*)

Updating the Science

The Task Force undertook a major reassessment of the state of the science for the causes, effects, and management actions for reducing Gulf hypoxia.

- In the fall of 2006, the Task Force agencies and the Sub-Basin Committees completed a series of four scientific symposia on the science surrounding Gulf hypoxia and nutrient sources, fate, and transport in the Mississippi/Atchafalaya River Basin.

- The Task Force completed a major technical report, *A Science Strategy to Support Management Decisions Related to Hypoxia in the Northern Gulf of Mexico and Excess Nutrients in the Mississippi River Basin* (MMR workgroup report), published in 2004. The report describes a framework for monitoring, modeling, and research activities to support management decisions related to achieving the three major goals of the *2001 Action Plan*. It describes the scientific information needed to support management actions and defines the scope, interrelation, and framework of the activities needed to provide that information. It also describes existing programs and activities, identifies gaps and limitations in those activities, and outlines the actions and resources needed to overcome the gaps and limitations.

- The Task Force completed a second major technical report, *The Management Action Review Team* report, published in 2006. The report is a compilation of information on point sources in the Mississippi River Basin and available programs that assist landowners, municipalities, and others in the Basin to reduce nutrient loadings. It also shows how such programs could more effectively address nutrient reduction if they were aligned and integrated with the Action Plan. The *Management Action Review Team* report represents the first time the Task Force has compiled a snapshot of programmatic information, and thus it can be used as a resource for future reassessments.

- In August 2006, the Task Force asked EPA's Science Advisory Board to provide independent advice on scientific advances since 2000 that might have increased understanding and options in three general areas:

1. ***Characterization of the causes of hypoxia.*** The physical, biological, and chemical processes that affect the development, persistence, and extent of hypoxia in the Northern Gulf of Mexico.

2. ***Characterization of nutrient fate, transport, and sources.*** Nutrient loadings, fate, transport, and sources in the Mississippi River that affect Gulf hypoxia.

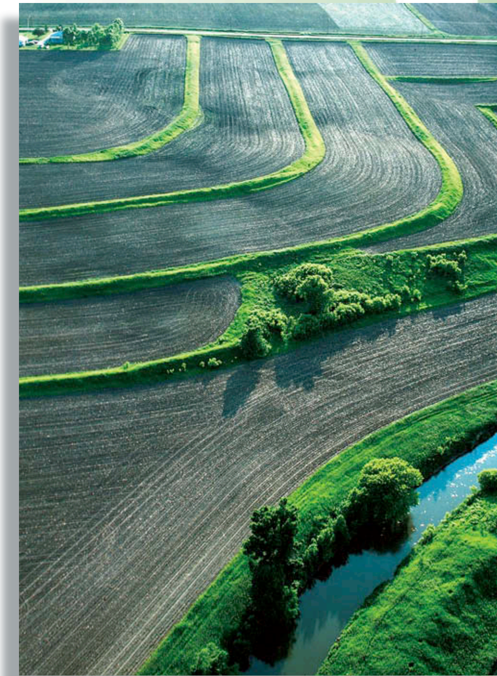
3. ***Scientific basis for goals and management options.*** The scientific basis for, and recommended revisions to, the goals proposed in the *2001 Action Plan*; as well as the scientific basis for the efficacy of recommended management actions to reduce nutrient load from point and nonpoint sources.

Conclusions from the Reassessment

Taken together, the state-of-the-science symposia, MMR workgroup report, *Management Action Review Team* report, and Science Advisory Board findings have advanced our understanding of hypoxia in the Northern Gulf of Mexico, as well as the factors contributing to it. Based on the complete reassessment of the science, the Task Force has agreed on the following main points which inform the actions in this plan:

- It is extremely important to accelerate actions that manage factors affecting hypoxia rather than waiting while science develops greater precision in revising the appropriate size goal for the hypoxic zone.

- The 5,000 square kilometer size of the hypoxic zone, the Coastal Goal set by the *2001 Action Plan,* remains a reasonable goal in an adaptive management context; however, it may not be possible to achieve this goal by 2015. The hypoxic zone, measured in July 2007, was the third largest measured.



Contour farming, conservation tillage, and conservation buffers protect soil and improve water quality on this farm in Woodbury County in northwest Iowa.

- While nutrients from the Mississippi/ Atchafalaya River Basin, coupled with temperature- and salinity-induced stratification, are indicated as the primary *causes* of hypoxia in the Northern Gulf of Mexico, other factors contribute to increased amounts of nutrients delivered to the Gulf, including:
    - Historic landscape changes in the drainage basin, primarily losses of freshwater wetlands, and increases in artificially drained areas that diminish the capacity of the river basin to remove nutrients,
    - Channelization and impoundments of the Mississippi River throughout the Basin and the delta and the loss of coastal wetlands, and
    - Changes in the hydrologic regime of the Mississippi and Atchafalaya Rivers and the timing of freshwater inputs that are critical to the stratification which is necessary for hypoxia. The diversion of a large amount of freshwater from the Mississippi River through the Atchafalaya has profoundly modified the spatial distribution of freshwater inputs, nutrient loadings, and stratification on the Louisiana-Texas continental shelf.

- Hypoxia has negative impacts on marine resources. Research on the deleterious effects of hypoxia on living resources in the Gulf suggests the occurrence of long term, ecological changes in species diversity, and possibly a regime shift (a large-scale, often rapid, reorganization of the entire ecosystem's food-web that is difficult and often impossible to reverse).

- Phosphorus also contributes to hypoxia. New information has emerged that more precisely demonstrates the role of phosphorus in determining the size of the hypoxic zone, requiring strategies that address both nitrogen and phosphorus.

- Significant reductions in nitrogen and phosphorus are needed. To achieve the Coastal Goal for the size of the hypoxic zone and improve water quality in the Basin, a dual nutrient strategy targeting at least a 45% reduction in riverine total nitrogen load and in riverine total phosphorus load, measured against the average load over the 1980–1996 time period, may be necessary.

- Total annual loads to the Gulf from 2001–2005 show a 21% decline in nitrogen load and a 12% increase in phosphorus load when compared to averages from the 1980–1996 period. However, during the spring period (April, May, and June) most of the reduction in total nitrogen load was from nitrogen forms other than nitrate, an important form fueling the primary production that leads to hypoxia development in the spring.

- Considerations of seasonality and nitrogen composition should be emphasized in nutrient reduction strategies. Recent scientific findings have affirmed that spring (April, May, and June) nitrate load from the Mississippi/Atchafalaya River Basin to the Gulf is highly correlated with hypoxic zone size. From 2001–2005, nitrate load to the Gulf during the spring period may not have changed significantly when compared to averages from the 1980–1996 period, despite a 21% decline in total annual nitrogen load and a 12% increase in total annual phosphorus load.

- New estimates of point and nonpoint source contributions are available. Point sources represented 22% of nitrogen and 34% of phosphorus loads, resulting in a higher percentage of the total load to the Gulf from point sources than estimated in 1999. Estimates of the point source load would be at the upper end of the range, as they assume delivery to the Gulf without any in-stream losses. Nonpoint sources, including atmospheric deposition, represented 78% of nitrogen and 66% of phosphorus loads; accordingly, these numbers would be at the lower end of the range.

- Anthropogenic nitrogen and phosphorus contributions have declined. Net anthropogenic nitrogen inputs (NANI) and net phosphorus inputs for the Mississippi/Atchafalaya River Basin have declined in the last decade because of more efficient use of fertilizer (as evidenced by increasing corn harvest and constant or declining fertilizer application rates). From 1999–2005, NANI calculations show 54% of nonpoint nitrogen inputs in the Mississippi/Atchafalaya River Basin were from fertilizer, 37% from fixation, and 9% from atmospheric deposition.

Steamboats are a historical reminder that the Mississippi River is a major artery of the nation's transportation system, sustaining commerce and economic growth.

Industrial Nutrient Discharge Reductions

Recognizing the impacts of nutrient pollution on the hypoxic zone in the Gulf, the Louisiana Department of Environmental Quality (LDEQ) works with industries and municipalities along the Mississippi River to reduce nutrient discharges, consistent with Action 8 of the *2001 Action Plan*. Voluntary programs, like the Louisiana Environmental Leadership Pollution Prevention Program (LaELP) engage professional, environmental, industrial, and municipal associations to improve the quality of the environment through pollution prevention, community environmental outreach, and environmental management.

Since 2000, the LaELP has recognized three industrial businesses for significant nutrient discharge reductions: IMC Phosphates (now Mosaic Industries), BASF Corporation, and ExxonMobil. Both BASF Corporation and IMC Phosphates have been acknowledged with "Special Recognition for Outstanding Nutrient Reductions," a category created to highlight Louisiana's special concern for hypoxia in the Gulf of Mexico and to emphasize the need for nutrient reductions.

Two **IMC-Agrico** plants were recognized for implementing a comprehensive, long range by-product management improvement campaign. This provides inactive phosphogypsum stacks with a synthetic liner and a clay/grass cover, and has resulted in more than an 80% reduction, over 100 million lbs., in average annual phosphorus discharges. While the program was voluntary, IMC-Agrico agreed to place the reductions in permits to ensure long-term compliance.

BASF Corporation was recognized for developing a biological treatment system that converts nitrates in wastewater — that would otherwise have been discharged to the Mississippi River — to atmospheric nitrogen and other non-nutrient parameters. Specifically, a new process was added that completed the denitrification process using “anoxic treatment” and specific bacteria that live in low oxygen environments that break down nitrates. The result has been an annual reduction of over 2.3 million lbs. of nitrates in BASF’s permitted discharged wastewater since implementation began in 1999. BASF has transferred ownership of the process to the Water Environment Research Foundation for wider use.

The **ExxonMobil Baton Rouge Refinery**, the second largest petroleum refinery in the nation, was recognized by both the LaELP and the EPA’s Gulf Guardian Award for reducing annual nitrate discharges from 4.1 million lbs. in 1999 to 1.5 million lbs. in 2003. ExxonMobil’s management team established a nitrate reduction objective and supported it through a five-year effort that included an extensive engineering analysis. As a result of the analysis, process operations were modified to run two ammonia strippers in parallel and the refinery wastewater treatment facility began operating under anoxic conditions. This reduction effort was not only voluntary, but was achieved without capital expenditure.

Recently, the Secretary of LDEQ reaffirmed the Department’s commitment to the many objectives of the LaELP and the special nutrient reduction effort in particular. As a result, the LaELP will continue to recognize activities and projects that demonstrate environmental leadership including innovative pollution prevention efforts implemented by its partners to reduce point source nutrient discharges to the Mississippi River.